CLAIMS:

I claim:

1) A regenerative heat-exchanger system for recovering waste heat from a hot gas by regeneratively transferring the heat from the hot gas to a cold gas, the regenerative heat exchanger system comprising:

a plurality of independently operable regenerative heat exchanger modules, each regenerative heat exchanger module sized for the processing of a fraction of the total design quantities of hot and cold gases, each regenerative heat exchanger module comprising

heat-sink material placed in the paths of flow of the hot and cold gases through the regenerative heat exchanger module, and

a flow control means having open and closed positions located in the paths of flow of the hot and cold gases for controlling the flow of the hot and cold gases through the heat-sink material, and

a regenerative heat exchanger module control means operably connected to the regenerative heat exchanger module to operate the flow control means of the regenerative heat exchanger module to enable the alternate flow of the hot and the cold gases through the heat-sink material to provide regenerative heat transfer of the heat in the hot gas to the cold gas; and

a regenerative heat exchanger system control means operably connected to each regenerative heat exchanger module control means to sequence the operation of the regenerative heat exchanger module control means of the regenerative heat exchanger modules so that the flow of the hot and the cold gas progresses sequentially through each of the regenerative heat exchanger modules whereby the operation of a rotary regenerative heat exchanger is simulated.

2) The regenerative heat-exchanger system of claim 1, wherein the regenerative heat exchanger system control means can select any number of regenerative heat exchanger modules from the total number of regenerative heat exchanger modules present in the regenerative heat exchanger system for operation.

3) The regenerative heat-exchanger system of claim 1, wherein the dimension of the regenerative heat exchanger module is less than 180 inches.

4) The regenerative heat-exchanger system of claim 1, wherein the flow control means comprises at least one gas flow control damper, the damper having a flow restricting member which is movable between an open and restricted position to enable or restrict the flow of the gas through the damper.

5) The regenerative heat-exchanger system of claim 4, further comprising a pressurized fluid actuator, the actuator connected to the flow restricting member to effect the movement of the flow restricting member between its open and restricted positions.

6) The regenerative heat-exchanger system of claim 4, further comprising an electric actuator, the actuator connected to the flow restricting member to effect the movement of the flow restricting member between its open and restricted positions.

7) The regenerative heat-exchanger system of claim 1, wherein the heat-sink material comprises a refractory material.

8) The regenerative heat-exchanger system of claim 1, wherein the heat-sink material comprises a metallic material.

9) The regenerative heat-exchanger system of claim 7, wherein the refractory material comprises a ceramic material.

10) The regenerative heat-exchanger system of claim 1, wherein the flow of the hot gas within the heat sink material is generally counter-current to the flow of the cold gas.

11) The regenerative heat exchanger system of claim 1, wherein each regenerative heat exchanger module processes an equal fraction of the total design quantity of hot gas.

12) The regenerative heat exchanger system of claim 1, wherein each regenerative heat exchanger module processes an unequal fraction of the total design quantity of hot gas.

13) The regenerative heat exchanger system of claim 1, wherein each regenerative heat exchanger module processes an equal fraction of the total design quantity of cold gas.

14) The regenerative heat exchanger system of claim 1, wherein each regenerative heat exchanger module processes an unequal fraction of the total design quantity of cold gas.

15) The regenerative heat exchanger system of claim 1, wherein the fraction of the total design quantity of the hot gas processed in the regenerative heat exchanger module is equal to the fraction of the total design quantity of the cold gas processed in the regenerative heat exchanger module.

16) The regenerative heat exchanger system of claim 1, wherein the regenerative heat exchanger modules are rectangular in cross-section, perpendicular to the direction of the flow of the hot and cold gases.

17) The regenerative heat exchanger system of claim 1, wherein equal numbers of regenerative heat exchanger modules are receiving the hot and cold gases respectively.

18) The regenerative heat exchanger system of claim 1, wherein unequal numbers of regenerative heat exchanger modules are receiving the hot and cold gases respectively.

19) The regenerative heat exchanger system of claim 1, wherein the regenerative heat exchanger module control means comprises an idle mode of operation wherein the flow control means is temporarily closed to generally shut off the flow of hot and cold gases through the regenerative heat exchanger module between the flows of the hot and cold gases into the regenerative heat exchanger module.

20) The regenerative heat exchanger system of claim 1, wherein the regenerative heat exchanger module control means comprises an off-line mode of operation wherein the flow control means is closed for an extended period of time to generally isolate a selected regenerative heat exchanger module from the hot and cold gases.

21) The regenerative heat exchanger system of claim 20, wherein the selected regenerative heat exchanger module is operated in the off-line mode of operation when the actual quantities of the cold and hot gases to the regenerative heat exchanger system are less than the total design quantities of the hot and cold gases.

22) The regenerative heat exchanger system of claim 20, wherein when the selected regenerative heat exchanger module is operated in the off-line mode, the remaining regenerative heat exchanger modules are continued to operate in sequence to continue to simulate the operation of the rotary regenerative heat exchanger.

23) The regenerative heat exchanger system of claim 1, wherein the regenerative heat exchanger system control means comprises an electronic programmable computer.

24) The regenerative heat exchanger system of claim 23, wherein the electronic programmable computer executes computer code which controls the operation of each regenerative heat exchanger module to simulate the operation of a rotary regenerative heat exchanger.

25) A regenerative heat exchanger system controller for simulating the operation of a rotary regenerative heat exchanger by using a plurality of independently operable regenerative heat exchanger modules, the control system comprising:

a plurality of regenerative heat exchanger module control means, each regenerative heat exchanger module control means operably connected to an independently operable regenerative heat exchanger module to enable the operation of the independently operable regenerative heat exchanger module as a regenerative heat exchanger having at least a heating mode and a cooling mode of operation; and an overall regenerative heat exchanger system control means operably connected to each regenerative heat exchanger module control means to control the operation of each of the regenerative heat exchanger module control means so that the heating and cooling modes of operation are sequentially progressed through each of the independently operable regenerative heat exchanger modules to simulate the operation of a rotary regenerative heat exchanger.

26) The regenerative heat exchanger system controller of claim 25 wherein the overall regenerative heat exchanger system control means can select any number of regenerative heat exchanger modules from the total number of regenerative heat exchanger modules present in the regenerative heat exchanger system for operation.

27) The regenerative heat exchanger system controller of claim 25 wherein the control means of each of the regenerative heat exchanger module further comprises an idle mode of operation which is also sequentially progressed through each of the regenerative heat exchanger modules to simulate the operation of a rotary regenerative heat exchanger having an idle sector.

28) The regenerative heat exchanger system controller of claim 25 wherein the regenerative heat exchanger module control means further comprises an off-line mode of operation which generally isolates its associated regenerative heat exchanger module from the hot and cold gases while the overall regenerative heat exchanger system control means continues to sequence the operation of the remaining regenerative heat exchanger modules to continue the simulation of the operation of a rotary regenerative heat exchanger.

29) The regenerative heat exchanger system controller of claim 25 wherein the overall regenerative heat exchanger system control means comprises an electronic programmable computer.

30) The regenerative heat exchanger system controller of claim 29 wherein the computer executes computer code which controls the operation of each of the regenerative heat exchanger module control means to simulate the operation of a rotary regenerative heat exchanger.

31) A method of operating a regenerative heat exchanger system having "M" independently operable regenerative heat exchanger modules, where "M" equals "N1 + N2 + N3" where "N1", "N2", and "N3", are integers, and "N1" and "N2" define the number of independently operable regenerative heat exchanger modules receiving a first gas and a second gas respectively, the first and second gases being selected from the set of hot and cold gases, "N3" is the number of idle independently operable regenerative heat exchanger modules equaling 0 or 1, the method comprising the steps of:

a) passing the first gas through a selected regenerative heat exchanger module for "P1" seconds;

b) idling the selected regenerative heat exchanger module for "P3" seconds where "P3" equals "N3*(P1+P2)/(N1+N2)" wherein "P2" is defined in step (c);

c) passing the second gas through the selected regenerative heat exchanger module for "P2" seconds; and

d) repeating steps (a), (b), and (c) for each selected regenerative heat exchanger module as long as required.

32) The method of claim 31, wherein in step (d), each selected regenerative heat exchanger module is operated in sequence and the operation of each selected regenerative heat exchanger module is staggered with respect to the operation of the other regenerative heat exchanger modules.

33) The method of claim 32, wherein the operation of each selected regenerative heat exchanger module is staggered by "(P1+P2+N3*P3)/(N1+N2+N3)" seconds from the operation of the preceding regenerative heat exchanger modules when "N3" equals 1.

34) The method of claim 32, wherein the operation of each selected regenerative heat exchanger module is staggered by "(P1+P2+N3*P3)/(N1+N2+N3)" seconds from the operation of the preceding regenerative heat exchanger modules when "N1" is not equal to "N2".

35) The method of claim 31, further comprising the steps of:

e) isolating one of the regenerative heat exchanger modules from the flow of the first and second gases; and

f) operating the remaining modules in a fallback mode of operation wherein either "N1" or "N2" or "N3" is reduced by one to adjust for the non-operational regenerative heat exchanger module therein and executing step (d) as long as required.

36) The method of claim 35, wherein if the regenerative heat exchanger module isolated in step (e) is in the set of "N1" regenerative heat exchanger modules which receive the first gas, "P1" is reduced to "P1*(N1-1)/N1" before step (f) is executed.

37) The method of claim 35, wherein if the regenerative heat exchanger module isolated in step (e) is in the set of "N1" regenerative heat exchanger modules which receive the first gas, the value of "P1" is unchanged while step (f) is executed.